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International trade in biofuels: an introduction to the special issue

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ABSTRACT

Currently, many countries are establishing goals for substituting biofuels for fossil fuels. These goals usually foresee 5–10% substitution while today's production, in most countries, is far below 2%. Evidently, many countries will seek to meet their ambitious biofuel targets through imports. This global trade in biofuels, which is to some extent already taking place, will have a major impact not only on other commodity markets like vegetable oils or animal fodder but also on the global land use change and on environmental impacts. This special issue focuses on the relation between trading, policy making and sustainability impacts of biofuels. It demonstrates the strong but complex link between biofuels production and the global food market, it unveils policy measures as the main drivers for production and use of biofuels and it analyzes various sustainability indicators and certification schemes for biofuels with respect to minimizing the adverse effects of biofuels while maximizing the benefits of the future use of biofuels.

1. Introduction

Our economy runs on oil, coal and natural gas; or, as Richard Heinberg summarizes, "the world is currently as reliant on hydrocarbons as it is on water, sunlight, and soil" [1]. Biofuels are the most obvious option to overcome the limits of our fossil-based society. First, biofuels are widely compatible with our existing filling-station infrastructure and they can be used with current vehicles. This allows a rapid introduction of biofuels on a large scale. Second, policymakers have had difficulty achieving reductions in greenhouse gas (GHG) emissions in the transport sector. Thus it came about that great hope was placed in the liquid form of biofuels. And finally, biofuels may improve energy security by reducing the dependence on imported hydrocarbons.

Interest in biofuel production tends to rise in insecure times such as World War II [2]. Interest waxed again during the oil crises in the mid 1970s, when Brazil's promotion of ethanol started and the European Commission took the recent conflict between Russia and Georgia as justification of its massive campaign of biofuels subsidies [3].

Currently, many western countries and some emerging countries are establishing goals for substituting biofuels for fossil fuels. These goals are often in the range of 5–10% substitution to be reached within the next 5 years [4]. However, today's production, in most countries, is far below 2% and huge efforts will have to be taken to increase the percentage supplied by biofuels to achieve these goals [5]. Obviously, many countries will not reach their substitution goals with domestic production. They will therefore seek to fill the gap and meet their ambitious biofuel promotion targets through imports. This global trade in biofuels, which is to some extent already taking place, will have a major impact not only on other commodity markets like vegetable oils or animal fodder but also on the global land use change and on environmental impacts.

1.1. Impacts of trade policy

The potential of energy crops is limited where biofuels are wanted most, i.e. in the industrial North. There have always been different regional endowments in arable land and climate, and thus as part of the integration typical of an age of globalization eventually a modest international trade in biofuels arose. This international trade brought imports of biofuels – whether as feedstocks or liquids – into competition with domestic products. For instance, in Europe subsidies were paid on soybeans (later a feedstock for biodiesel) and sugar (later a feedstock for bioethanol). Soybeans caused a trade dispute that lasted twenty years [6]; the long-standing case of European sugar subsidies and their tortuous removal are described in Ruddy and Hilty [7].

Trade policies often induce unwanted effects, e.g. overall GHG emissions might increase due to indirect effects although the policy was originally designed to reduce the carbon footprint of the subsidized product [8]. Policy impacts are especially complex for biofuels, because policy measures take place on various levels, such as agriculture policies, renewable energy regulations, the clean

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development mechanism, sustainability criteria or fuel taxes. In order to design a bioenergy policy efficiently it is crucial for decision makers to understand the overall effects of certain policy measures on the market and on the environment.

1.2. Small scale vs. large scale

In contrast to fossil fuels, biofuels allow for decentralized energy supply by using the energy locally where it has been produced. By increasing local energy autonomy, biofuels may contribute to the empowerment of rural communities in developing countries. Although social and environmental benefits can be significant, the economic feasibility of decentralized biofuels supply remains an open question [9].

On the other hand, in the face of rising oil prices, agriculture-based developing countries have the opportunity to enter the league of oil exporting countries by switching to biofuel production. The demand for biofuels in the OECD countries is large and agricultural conditions and underutilized land favour large-scale plantations in rural regions of Africa and South America. The assessment of environmental and social impacts of such energy plantations is therefore mandatory to understand the overall sustainability of such biofuels.

1.3. Energy crops vs. food and feed production

Food, feed and biofuel production compete for the same agricultural land. This competition, further distorted by subsidies, is already having a great impact on food and feed prices and consequently on food availability [10]. The world market prices for sugar and for corn have risen substantially due to the rapidly growing production of bioethanol from sugar cane in Brazil and from corn in the U.S. One positive effect, however, is that some European countries may reduce their excess production of food by switching to energy crops, at the cost of trade-offs with other factors. Nevertheless, the land occupation for producing energy crops is enormous if only 5–10% of the global fuel production should be substituted by biofuels. In addition, this competition for arable land must be assessed under the perspective of a growing population, an increasing demand for meat, and a decreasing trend in yield gains.

1.4. Certification of sustainable biofuels

There seems to make common sense for sustainability certification to be an important prerequisite for managing the overall impacts of biofuels. For biofuels, however, sustainability certification is more complex than for wood or agricultural commodities, as both agricultural and industrial processes are relevant. Currently, various certification schemes are under parallel development such as the UK Renewable Transportation Fuel Obligation RTFO [11], the Swiss mineral oil tax redemption for sustainable biofuels [12], the EU directive for renewable energy [4], or the voluntary criteria of the Roundtable for Sustainable Biofuels [13]. This plethora of certification schemes creates an unclear situation for producers, and weakens society's acceptance of sustainability measures. Widely accepted criteria are urgently needed that comply with the Brundtland definition of sustainability, are compatible with existing labels (e.g. for sustainable forestry [14]) and are based on sound scientific knowledge.

2. Overview of contributions

2.1. Impacts of trade policy

This special issue starts with five articles researching the impact of trade policies on the various biofuel and bioenergy markets. In their article, "Bio-energy Policies in a Global Context", Kaditi et al. examine how a possible reduction and elimination of trade barriers along with a phasing out of trade distorting support measures would contribute to the development of a global sustainable bio-energy market.

Cynthia Lin et al. analyzed the import demand for Brazilian ethanol. One important finding from this study concerns mandatory blends of renewable fuels. Results from Lin's team indicated that import tariffs have had little impact on the quantity of imports. Instead, mandatory gasoline/ethanol blends are a much more important determinant of ethanol imports.

Unlike most other authors, Lundmark et al. examined solid biofuels, and how EU policy was intended to increase renewables' share in home heating. They analyzed EU policy on the basis of the White Paper and the RES-E Directive. Paradoxically, depending on policy implementation, the results differed: a country that was *net importing* given the White Paper implementation could instead be *net exporting* when applying the RES-E Directive.

In their paper "Future bioenergy trade in the EU – cost-effective trading options" Hansson et al. defined "trade" quite differently from other authors. A question was raised by representatives of IEA Bioenergy Task forces as to what was the most cost-effective form in which to trade: biomass itself, or electricity generated from it; further alternatives considered were renewable certificates or CO_2 credits. The purpose of the paper was to analyze under which combination of targets for CO_2 emission reduction and biofuels for transportation that trading solid and/or liquid biofuels and CO_2 credits would be cost-effective in the EU from the perspective of an optimization energy systems model.

Upham et al. reviewed the sustainability of various biodiesel feedstocks under the UK regulations. The team discovered that the only form of biofuel ensuring sustainability benefits was used cooking oil. Hence, the UK's Renewable Transport Fuel Obligation (RTFO) risks causing substantial, adverse environmental effects.

2.2. Fuel vs. food

The next two papers deal with the competition between the production of food and biofuels. Reinhard and Zah evaluated the global consequences of an increased biodiesel production in Switzerland on greenhouse gas (GHG) emissions and environmental impacts. They found a strong linkage between rape-methylester production (RME) and fodder production. In sum, the environmental impacts of an increased RME-production depend on the environmental scores of the marginal replacement products on the world market rather than on local production factors.

Schuetz and Bringezu quantified the global land area needed to meet the German consumption of agricultural products and the related GHG emissions. In terms of land use, Germany is already a net importer today, and the additional land needed by 2030 is estimated as 2.5–3.4 million hectares. This is mainly due to biofuel demand driven by current policy targets. Meeting the required biodiesel import demand would result in an additional GWP of 23–37 tons of CO_2 equivalents through direct and indirect land use changes.

2.3. Small scale vs. large-scale cultivation

Two papers deal with the potential impacts of small scale vs. large-scale biofuels projects. Martin and Eklund have analyzed the current situation in Tanzania. Small scale bioenergy projects, driven by increasing energy prices prevail in Tanzania. However, any growth of foreign investment for large-scale biofuel production will continue to be inhibited until land issues and tax concerns are settled in a national biofuels policy.

Matos et al. analyzed the pressure exerted on developing countries to adopt large-scale mechanized farming practices to increase economic efficiencies. Such pressure from international markets to become more economically efficient may contribute towards the erosion of recent schemes to encourage social benefits for small farmers in biodiesel production thus exacerbating poverty and social exclusion.

2.4. How to promote sustainable biofuels?

Finally, four papers discuss ways to promote biofuels keeping in mind the overall goal of sustainability. Buchholz et al. analyzed how 46 experts scored 35 sustainability criteria with respect to relevance, practicality, reliability, and importance. Energy balance and greenhouse gas balance were perceived as especially critical. Social criteria and locally applied criteria ranked generally low in all four attributes. Although being perceived as important, food security ranked very low in both practicality and reliability.

Timo Kaphengst et al. analyzed how the debate on biofuel standards is generating innovative ideas for the general future of standardization and certification schemes. Although consumer demand for environmentally and socially responsible products is the driving force for certification systems, this has led to an increasingly crowded marketplace for labels and confusion among stakeholders. The article explores how a global generic standard-setting scheme for natural resources could be created, driven by ongoing biofuels certification activities.

Zah et al. developed a "Sustainable Quick Check for Biofuels" (SQCB). The assessment of environmental impacts along the life cycle of biofuels is a complex task that cannot be afforded by small producers in developing countries. Therefore, certification schemes bear the risk that small producers will be locked out and the market for sustainable biofuels will be dominated by international investors and large-scale plantations. One major goal of the SQCB is to support the market entrance for local biofuel producers, given that strengthening local stakeholders is a key driver for empowering rural communities in development countries.

Finally, M. Valentine Florin concludes this special issue by summarizing the governance guidelines developed by the International Risk Governance Council (IRGC). These guidelines comprise an integrated and coherent set of policy recommendations and practical actions to help policymakers and industry account for the various trade-offs presented by bioenergy and develop sustainable bioenergy production for domestic use and international trade.

3. Conclusions

The papers of this special issue demonstrate that increased biofuel production is highly interlinked with other trade activities, multi-faceted in its impacts and strongly dependent on policy measures. Consequently, it was not possible to assess the overall and global impacts of biofuel trading on environment and economy. Nevertheless, in summarizing the results of this issue, some conclusions can still be drawn, which may help to minimize the adverse effects of biofuels while maximizing the positive potential of the future use of biofuels.

- Policy measures are the main drivers for the production and use of biofuels. However, the effects of policies differ widely depending on global market conditions and the effect of other policies.
- The production of biofuels is strongly linked with the global food and feed commodity market. This linkage is induced by competing for agricultural land rather than for feedstock. Consequently, future production of biofuels should be decoupled from land competition and rely basically on residual materials.
- Small scale bioenergy projects usually allow for environmental and social benefits with relatively low risks. Large-scale projects, in contrast, usually have higher economic risks, while social benefits may be negative.
- Certification schemes that are global, transparent and easy to implement are under development. Such certification schemes are a prerequisite for the global introduction of sustainable biofuels.

We hope that this special issue will foster the dialog among the various experts in biofuels and trade. Only the interdisciplinary integration of all aspects from agronomy and forestry, industrial ecology to technology development, international trade and government policies will lead us to a sustainable use of biomass-based energy.

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